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## Final Report for NASA Grant NAG-2 605:

### Heterodyne Observations of Galactic CII on the NASA Kuiper Airborne Observatory

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This project had three flight series in December 1990, August 1991, and October 1991. The flights were taken using the far-infrared heterodyne receiver built by Al Betz and Rita Boreiko. On these flights we observed many Galactic sources in the  $158 \mu\text{m}$  line of ionized carbon ( $\text{C}^+$ ). The sources observed include HII regions: W3, W51, G34.3+0.2; photo-dissociation regions: NGC 7023, NGC 7027, IC 63, IC 1396, the Orion Bar; and a supernova remnant: IC 443. Although some of these sources had been observed before in the  $158 \mu\text{m}$  line of  $\text{C}^+$ , it is the first time that most of them have been observed with high spectral resolution. Most of the sources were detected with a high signal-to-noise ratio.

These observations have resulted so far in several papers, with more planned. The publications are:

1. "Physical and chemical structure of the IC 63 nebula. III. Gas-phase carbon abundance." D. J. Jansen, E. F. van Dishoeck, J. Keene, R. T. Boreiko, and A. L. Betz, 1996, A&A, 309, 899.
2. "Millimeter and submillimeter observations of the Orion Bar. II. Chemical models." D. J. Jansen, M. Spaans, M. R. Hogerheijde, and E. F. van Dishoeck, 1995, 303, 541.
3. "Neutral and Ionized Carbon in the Envelope of NGC 7027." K. Young, J. Keene, T. G. Phillips, A. L. Betz, and R. T. Boreiko, 1998, ApJ, in press.
4. "CO, CI and CII Observations of NGC 7023." M. Gerin, T. G. Phillips, J. Keene, A. Betz, and R. Boreiko, 1998, ApJ, in press.

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